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ON THOROUGH LAND DRAINAGE, AND THE RESULTS OF ACTUAL OPERATIONS IN CANADA.

*A Paper read by H. J. Boulton, Esq., of Humberford, Etobicoke, before the
City of Toronto Electoral Division Agricultural Society, March 3rd, 1863.*

How little are we aware of, or do we appreciate the intimate relationship and similarity which exist between the animal and vegetable world. This similarity is shown in an almost startling manner by the investigations of chemists, who in their researches have proved that one of the necessary constituents in the formation of all animal, as well as vegetable bodies, is sulphur, and that the sulphur compound dissolved in the juice of plants is identical with the albumen contained in the serum of the blood and in the white of an egg; that the sulphur compound in the seeds of the cereals, possesses the same properties and composition as the fibrin of the blood, and that the nutritious constituent of peas and beans is actually of the same nature and composition as the casein of milk.

This identity then having been established in the actual constitution of these two kingdoms, let us pursue the comparison further into the conditions of life of their members. What are the consequences liable to animals of being fed on an impure and scanty diet, of breathing a vitiated atmosphere, of resting in a reeking loathsome lodging? Is it not a slow and stunted growth, the form shrivelled and prematurely aged, and its very poverty feeding its further misery by the propagation of noxious vermin over the surface of the body? Compare this state of things with an analogous one in the domain of vegetable life. A tree is planted in a poor and barren ground, soured with stagnant water, in a dank and heavy atmosphere. Its growth also, spindling and weakly, soon ceases; if it bears fruit, this is shrivelled, every branch and fibre will be found covered with parasitic insects, while the very flow of the sap is arrested by canker and decay. I have now adduced a case to which every eye can be witness, on account of the size of the example I have set forth, and lengthened period during which these results are produced from the conditions I have supposed. Continuing our examination down to the lower orders of vegetable existence, I think very slight consideration will lead us to the irresistible conviction, that the same effects are worked even more fatally when the plant lives but through a few short months, instead of years. A warm and dry lodging, with a free and moderately moistened atmosphere, are necessary appliances of the bodily comfort of animals; the same are indispensably requisite to vegetable healthfulness. It is not every one that seems awake to the fact, that his dumb animals stand in the same need, even comparatively, of the same treatment as himself, much less would it be generally supposed that the motionless, breathless herb could be amenable to evils or necessities in any way akin to those of either. The subject of this paper leads us at once to an element which, by the excess or sufficiency of its supply, affects to the last degree every form of life. I mean, of course, water, and it is to the command and control of this element that much of the labor of the husbandman has been directed, though the How and the Why have been generally too little understood and considered. As a soil impoverished by a super-abundant and stagnant moisture will produce a plague of mosses and parasitic insects upon the stalwart denizen of the forest or orchards, so will the same causes produce the

like effects in the many pests to which our grain crops are found liable to become the victims. Could our soils at some times be freed from too great humidity, at others furnished with sufficient moisture and otherwise fed, strengthened and supplied by judicious cultivation, the plague of rust and mildew, and the ravages of the midge and other insects would have little power to affect them. In order successfully and effectually to accomplish the former of these operations, there has been invented, developed, and perfected the science, I may call it, of underdraining, which has been thoroughly and admittedly adopted and accepted in the old countries of England, Scotland, and Ireland, as the only sure basis of successful Agricultural Improvement. The use of this method of work has only been adopted generally during the last few years, though the idea itself is by no means new, and the wonder is, not that it was so long before being discovered, but that, having been discovered, so long a period has elapsed before being received into practical favor. It is even said that drain tiles have been found in old Roman excavations, but however this may be, we have handed down to us a treatise dedicated to the Protector Cromwell, fully expounding the principles which are now strictly followed in the treatment of lands affected with too much moisture. This was by Captain Walter Bligh, and he says:—"For thy drayning trench, it must be so deep that it go to the bottom of the cold spewing moyst water that feels the flagg and the rush; for the wideness of it use thine own liberty, but be sure to make it so wide as thou mayst go to the bottom of it, which must be so low as any moysture lyeth, which moysture usually lyeth under the over and second swarth of earth in some gravel and sand, or else when some greater stones are mixed with clay, under which thou mayest go half a spades grass deep at least. Yea, suppose this corruption that feeds and nourishes the rush or flagg should lie a yard or four foot deep, to the bottom of it thou must goe." On the filling in of drains he speaks of using—"Good green taggots or pebbles or flint stones, and fill then into about fifteen inches high, and take thy turf and plant it aforesaid, the green sward downwards being cut very fit for the trench, so as it may joyne close as it is layd down, and then having covered it all over with earth and made it even as the other ground, *waite and expect a wonderful effect through the blessing of God.*" Bligh's suggestions do not seem to have been adopted. And although some instances of thorough draining have occurred during a period of more than a century ago, yet no system was introduced till, in 1764, Joseph Elkington, a Warwickshire farmer, discovered a system of strata draining by deep trenches and boring, which, in some soils is most successful; and subsequently, Smith, of Deanston, introduced the system of shallow and frequent drains, when land was not affected so much by springs as by the stagnation of rain water. From these beginnings, the system has progressed to its present perfection of deep tile drainage, with cylindrical pipes, introduced under the auspices of Josiah Parkes, within the last twenty years. Although even this is not entirely new, as some lands are now to be seen which were drained deep with tiles 40 years ago, to which they owe their present excellent condition, the work having been carefully done, and still remaining effective.

The two systems introduced by Elkington and Smith have each of them their extreme advocates, as is the case with every other subject. This discrepancy of opinion with regard to them arises probably from want of varied experience. The man who deals solely with light and springy lands and subsoils, does not perceive that the treatment he successfully applied in his experience, would utterly fail and be useless in denser soils, and when the trouble did not arise from under-water. He on the other hand who found it necessary to use shallow and frequent drains, on account of the heavy and retentive nature of his soil, injured only by stagnant top water, would fail to appreciate the capability of water to permeate through any stratum to any greater distance than the few inches in depth and feet in width affected in his own experience.

Elkington's system was accidentally discovered by himself, while digging an

unusually deep trench, when he was very much plagued with water. He happened to force a crow-bar four feet through the bottom of the trench, with a view of ascertaining the nature of the subsoil, and on pulling it out, was surprised to find the water gush up from below. From this was derived his system of draining water-bearing sub-strata by tapping or boring, which in certain situations is the most economical plan for the escape of the water; but it has been found altogether inapplicable to land which consists to a great depth of absorbent earths, and in other cases very much of the practice of Elkington has been superseded by the later methods of deep draining. At present the general adoption of a rather uniform depth of four feet draining, which has been found in most cases advantageous, has originated an impression which should be removed, being perhaps a stumbling block in the minds of some against the favorable consideration of the subject, namely, that the advocates of Tile draining would drain all lands in the same manner and for the same purpose. We will speak first of the Lands. All lands certainly do not require draining. This is a matter which entirely depends upon the nature and shape of the different sub-strata.

Lands may be classified in two ways, sandy or clayey, and level or rolling, or sloping. I will first dispose of those which may not require any of this treatment.

Let us take a porous soil of moderate depth, composed in some cases of sand, in others of light loam or clay, of perhaps a rather stony nature, underlaid by a bed of gravel. If this gravel rests upon a bed, which follows the slope of the surface, or falls independently of the slope of the surface, so as to allow the water to run away through the gravel, such lands will require little or no attention in this respect. All that such soils require will be judicious tillage and manuring. As they are well open to the atmosphere, and easily tilled and entered by the roots of all plants, so their fertile qualities are more easily and entirely drawn out and exhausted from them than from heavier soils, and when this has once been done, a greater expense will be necessary to restore those qualities from sources foreign to the soil itself. It is the penetrable nature of these soils, so easily yielding up their fertilizing substances to plants growing upon them, that leads many to suppose that these substances are washed down by the rains deep into the soil out of reach of the roots, which are the mouths and feeders of vegetation. This is a mistake I think easily corrected by an examination of the water which escapes from the outfalls of underdrains, which will be found perfectly clear and pure even after very heavy rains when the volume of water discharged is very great, and in all such permeable and friable soils a very slight investigation proves that the roots of plants will penetrate an almost incredible distance, attracted, as it were, by the food necessary for their growth. This very tendency has occasionally caused great difficulty in draining. It is well known that there is no better or richer fertilizer than living spring water. This lies at the bottom of the principle of irrigation, and it has occurred where spring water has been led underground through common tiles, that the roots of crops planted in the field, through which this water has been conducted, have penetrated through the intervening soil, found their way into the fresh running water, spread through the pipes and effectually stopped them up. An instance of this has already occurred within my own experience. In the autumn of 1858 a three-inch horse shoe tile drain was laid down through a low springy piece of land. Being done during my absence, the man failed to follow my directions, and made the drain only about 20 inches deep. This, of course, partially dried the ground, and a constant stream of water was discharged from the mouth. Last autumn, a year after, I had the drain taken up, and laid down again four feet deep, when from the low gravelly subsoil I have drawn off a very large flow of water. Within a few feet of this drain a willow tree is growing, and when the workmen got up the old drain to about thirty-five feet from the tree, they found the whole pipe filled with fibrous roots, which had grown all

that distance down the running stream of water, and would no doubt eventually have choked the pipe. Unfortunately, I was not present when this obstruction was found, and in taking up the drain the man cut the mass into a number of short pieces, some of which I preserved, and have brought with me to exhibit, as the best exemplification of the difficulty I am speaking of. This will necessitate the destruction of the tree, as I have no doubt that the same will occur even at the depth of the present drain, as from the springy nature of the ground there will be a permanent flow of water.

The next class of land that I shall speak of is a sandy or other porous soil, underlaid by a gravelly or other permeable substratum. In many cases the course of the stratum below this again is greatly diversified with undulations and inequalities which embarrass or effectually debar the underflow, as it were, of the water, which is thus gathered and pent up in what may be termed subterraneous ponds, where are bred all the evils of stagnation almost as effectually as if the impediments existed on the surface. The evil in these cases may be successfully treated by the insertion of a very few branches, the duty of which will be simply to cut through the walls of retentive soil which impede the flow of waters already gathered in the permeable underlying stratum. There are many cases also, where the sandy or loamy soil lies very deep, but is fine and close in its nature, and holds a large quantity of water suspended in it by capillary attraction, similarly to the action of a sponge. A few branches in such soil will be most beneficial, especially when the ground is level and flat in its formation. In such soils as I have described, there is of course no necessity for drainage, when no water ever appears on the surface, or, on digging trial pits, say three or four feet deep, a few hours after heavy rain, no water is found standing in them. I hold however, the decided opinion, that wherever it is found necessary to have open furrows in ploughed or meadow land, to carry off rain or snow water, there underdraining is wanted. The escape of water by the surface is absolutely detrimental, and a waste of one of the most important sources drawn upon by nature for fertilizing and enriching the ground.

The two great cases, where perhaps it is patent to every mind that underdraining will be necessary, are: First, hilly and uneven lands, where strata of earth replete with moisture crop out to the surface, and discharge upon the lands beneath, slowly but constantly, their injurious springs, which we should hasten to tap before the water finds its way to the surface. Secondly, all low lying lands, from which, on account of the evenness in the formation of the ground, it is evident that it will be impossible for any water which exists in injurious quantities upon or beneath the surface to find a timely escape by any other means.

I have reserved for the last consideration a class of lands which are, perhaps, the most valuable description of all, and to which it is generally supposed that any treatment of this kind is the least applicable. I mean dry clay or other strong lands in every respect situated in the most advantageous manner. Fine, high, sloping, undulating lands, from which it is generally supposed to be the easy duty of good and judicious ploughing to lead off at once all the water which falls upon them. And I do not wonder that unthinking men should rebel against the idea of *draining* such lands, in which perhaps they have already sunk wells, thirty and forty feet deep, without meeting a drop of water, and beneath the surface of which they have found, to their cost, that the heaviest showers of rain can scarcely penetrate. This prejudice against, and distrust of the principles of draining, is produced and fed by what in this case is a misapplication of terms, but may, I think, be counteracted and disarmed by a view of the subject which I have as yet never seen or heard advanced or explained. Although the mechanical means in all cases are the same, yet in this class of lands the first effect of the work is so entirely different as almost to induce the change of name, and instead of drainage it should assume the name of *ventilation*. The effect of this operation upon these soils is to bring the atmosphere into immediate con-

tact with them, by which a process of disintegration will be brought about and the soil gradually opened, so as to admit the moisture, and, in our climate especially, the inestimable benefit of the low degree of temperature so common during our winters, and which in this respect is a most invaluable blessing. Frost is well known by experience to be the most effectual and rapid pulveriser, and the earth having once been opened and lightened by it, thus allowing rain and other moisture to be absorbed into it, if this moisture be carried off by artificial means beneath, instead of being drawn out by evaporation above, the atmosphere, with its accompanying beneficial influences, will necessarily follow down after it, thereby maintaining and increasing in the soil that free and open condition previously commenced. I have before alluded to the loss sustained by allowing the water which falls upon the earth to escape by the surface instead of finding its way beneath. The loss is double—first the positive removal from the cultivated bed of soil of the many fertilizing substances existing in it, by solution with the water thus permitted to escape, thus in fact absolutely robbing the land when it should be subservient to its increased fertility. A negative loss is the second, and is more thoroughly so in the case of those dry, hardened clay lands, than of those which are more penetrable by rain and air. This fact will be more clearly recognized when we consider whence is derived that most indispensable element of all vegetable structures, viz : nitrogen, which is furnished to the soil in the shape of ammonia, a combination of hydrogen and nitrogen. Ammonia again is supplied almost entirely from the atmosphere, into which it is ever escaping from the decomposition of previously existing substances, both vegetable and animal, and having an irresistible affinity for water, it is constantly conveyed to the surface of the earth, either in dew or rain, or snow. If then our lands are naturally incapable, and no means are used to enable them to admit these agents of supply, it will be easy to account for the absolute barrenness to which thousands of acres of such soils are now reduced. Even those ingredients which already exist in the soil, can only afford nutriment in a greater or less degree to plants in proportion as by the plentiful or limited circulation of water through them, they are enabled, when dissolved, to be assimilated as food by the delicate organization of their roots. In dense soils these important changes will necessarily take a longer time to develop themselves than in light ones. In the latter description, the benefits of drainage will be visible immediately, the water having already access to the earth beneath, and an outlet only is wanted for it to admit of an immediate circulation of air and moisture through the soil. While in the former the nature of soil has to be affected by the slowly operating action of the atmosphere before the water will begin to penetrate the obdurate mass, unless the drains be shallow and close together; and here arises the main difficulty in determining the plan upon which the drainage is to be carried out.

In some soils, as far as the efficiency of the drainage is concerned, they can hardly be too deep; and it becomes a matter of economy of labor whether they shall be deep and distant or shallow and frequent. Each foot that is added to the depth of a drain will almost double the previous expense of the whole. Cases will occur where the sinking of very few drains of six or perhaps more feet in depth will obviate the necessity of any further work; but, in general, four feet is found the best depth to which drains should be sunk, and then the nature of the soil must guide our judgment as to how far they should be placed from each other, the distance varying from thirty to forty and sixty and even more feet apart. This space of four feet will give an ample range for the roots of plants, and, when once the stiffer soils become opened and rendered permeable to water and air, will contain a good supply of moisture, held in suspension in it, and at the same time water which may exist beneath will not be drawn up by capillary attraction too near the surface, and will yet be within reach for supply by the same means. There are few soils in Canada that would require a less depth than four feet, and with this depth a distance of thirty-three will I think

be generally found sufficiently close. When the density of the soil required them to be placed closer together, I would diminish the depth, but the minimum should not be less than three feet. In England some people contend that no drains should, under any circumstances, be laid at a less depth than four feet, while others affirm that in some very heavy and retentive clays four feet drains are perfectly inoperative, and have been obliged to be replaced or assisted by three feet drains at less intervals. It would therefore seem advisable when a soil of this extreme character is met with, to lay out the drains for a depth of three feet at a distance of twenty-two feet. This will give 120 rods per acre instead of eighty, under the former calculation of the smaller branch drains. But as under ordinary circumstances the expense of four feet drains will be 16 or 17 cents per rod, and that of the three feet drains not over 8 or 10 cents, the main difference will be the additional number of tiles, say 660, which, at \$5 per thousand, and deducting the difference, which will be in favor of the three feet digging, will give an increased expense of, say \$5 per acre. This expense, however, may be incurred with the confident expectation of a full remuneration. Such soils, by the opportunity afforded by the effects of this treatment of easy, deep cultivation, at all times will be found to contain within themselves almost inexhaustible sources of vegetable wealth. In some remarks by Mr. Johnston, of Geneva, N.Y., lately quoted in our Provincial papers, he expresses his opinion that it is useless to sink drains any lower than the bottom of the porous soil, and that in his own land, when he meets with a hard, impervious substratum, at a depth of about thirty inches, he does not attempt, nor would he recommend, any deeper drainage. Unless the soil above this stratum is itself also of an extremely dense and retentive nature, I think that Mr. Johnston's opinion and practice are unsound; for, if the upper thirty inches of soil is of at all a permeable nature, there would be no difficulty in the water reaching through the lower twelve or eighteen inches, making in all four feet, which would then form a large reservoir, for the collection of water which could not immediately escape by the drains, in case they were of less depth, and would at the same time afford greater range for the roots of crops planted on the surface. It should also be borne in mind that there are few soils, however tenacious, which are entirely uniform, and not continually intersected with numerous veins of sand, and other porous material. To persons who have not and will not take the trouble to examine for themselves, the accounts of the depth to which the roots of plants will penetrate seem absurd misstatements. In a field drained by myself last spring (1859) to the depth of four feet, of a moderately stiff, though not extremely retentive clay, I followed the root of a carrot down thirty four inches, and then failed to find the end, the size of the root where it broke off being still 1-16th of an inch in diameter. This, too, was in a soil which I believe has never been manured.

The next point, upon which there is a diversity of opinion, is the direction in sloping ground in which the small branch drains should be run. The majority of opinions, and with them I agree, are in favor of running them immediately up the slope, and not transversely to the fall. There certainly are situations where one or two transverse drains will be most beneficial to intercept the water when it issues below a rise of ground; but, in most lands thoroughly drained, those drains which are dug transversely only drain from the upper side, while those in the contrary direction will act on both sides, which will make the drainage more uniform and perfect. I will now proceed to give some explanations as to the mechanical performance and probable cost of the work. Clay lands, though more laborious to work, are the simplest and easiest to drain securely, on account of there being little danger of the pipes being filled by the soil running in; so that although the labor part may be more expensive in the first instance, yet it is more likely to be safely done and permanent; and the best season for doing the work is when the ground is wet, as not only it is then easier to dig, but the water with which the soil is charged serves as the most

correct index of the fall being properly kept. When this simple guide is not present, a common bricklayer's level, about twelve feet long, will be the most available gauge of the perfection of the work; and the whole amount of fall in the field having been first ascertained, a false bottom can be adjusted to the level, which will give the proper slope to each section of the entire drain. In all cases I would recommend the land to be well ploughed, leaving deep open furrows at regular intervals where the drain is to be laid. If this is done, and the furrow filled with long stable litter in the autumn, this work can be proceeded with as easily during the winter on clay lands as during any other season. The next step will be to remove the loose earth from the furrow, and take out the first spit with a common spade, opening the trench to the width of from twelve to fifteen inches at the top, and gradually contracting in its descent; the remainder of the trench can then be taken out at two draws, with what is called the grafting tool, a round-backed spade, the blade of which should be about seventeen inches long, and five wide at the point, being wider above; the handle should be straight and strong, and almost in a line with the blade. Many suppose that different-sized tools are necessary to contract gradually the trench, so as only to receive the tile at the bottom, but a skilful workman with the above tool will narrow down the opening to any size required. After the last draw is taken out, the crumbs are removed and the bottom levelled, and shaped exactly to receive the tile with a long narrow-bladed scoop, drawn towards the workman. The tile is then laid in either by a man down in the trench, standing on each last-placed tile with his face to king up the drain, or standing on the surface of the ground and reaching down the tiles with a long-handled hook, which is inserted into each pipe. This latter is the better plan, especially in wet weather. For sandy lands some modifications will sometimes be necessary. If there is a stratum of clay within any reasonable distance of the surface, and the depth of the outfall will admit, the drain should be sunk down to it, as the clay not only forms the best bed for the tile, but furnishes the best covering for it also. In this case, from the greater depth of the drains, they can be placed much farther apart. If, however, such a stratum is not at hand, I think the following is the only safe and at the same time economical way of proceeding:—The bottom of the drain should be formed so as to admit a strip of board about an inch wider than the tile, which is to be laid upon it. Clay should then be sought and carted in from other places, and the tile covered to the depth of three or four inches with it. There are few situations where clay is not to be found near at hand, and I think it the only reliable means of isolating the tile from the sand, which otherwise is sure to find its way through the joints of the tiles, unless we have recourse to the expensive plans adopted in England in difficult cases of this kind, which is to put tile collars on the joints of the pipes, and even sometimes entirely encase small pipes in others of larger size; and even this I do not think so safe a plan as the board with the clay covering, and generally it will of course prove vastly more expensive. This method I found necessary to adopt after several failures in attempting to lay pipes through a wet, boggy piece of land, which is now perfectly dry and planted with winter wheat last spring, after it was drained, being the first time it ever was ploughed. In draining land of this description, the work should be kept close together, and the tiles laid well up to the workmen and covered in as quickly as the trench is dug, and no more of the trench opened than is to be finished at once, for, as soon as the ground is opened, the water begins to gather, the soil becomes weakened, and the sides will soon fall in, thereby producing a great increase of labor, trouble, and consequently expense.

As to the cost of the work, I am, I think, able to show conclusively that this work is within our reach, and perfectly applicable to our condition in an economic point of view. Within the last twelve months I have laid over 40,000 tiles, averaging four feet deep, at a rate of expenditure for which the in-

creased fertility of the soil will afford an immediate full return, although a large expense was incurred at first from want of that skill which practical experience only could give. The whole expense of laying these 40,000 tiles very nearly amounts to \$500, and the men employed have many of them earned over the average amount of wages when they worked by the piece. Part of these were laid during the last two months; and though the men worked very short hours constantly, not over eight hours a day, they earned 66 cents on an average, at $16\frac{1}{2}$ cents per rod, digging, filling and laying pipes. The actual cost of the above tiles was \$8 per thousand for two-inch, \$7 for one and-a-half inch, and \$12 50 per thousand for three-inch, at the kiln. Two-inch pipes can now be had at \$6 50 per thousand, one foot long, but if a larger demand was to spring up they could I think and no doubt would be furnished at \$5 per thousand.

Most of this work having been done recently, I can give but a limited exposition of the benefits of tile draining from my own experience. The results of one field, however, are most satisfactory, as the following account will show. The field is the best on my farm, and consequently has been perpetually under crop since it was first cleared, but, from the ordinary rack-rent system of Canadian farming, has never received any manure from the same date. In 1857 a very poor crop of rusted, shrivelled winter wheat, about 13 bushels to the acre was the yield. In 1858 the land was reduced to an apparently excellent condition by ploughing and scarifying, and potatoes planted about the 8th or 10th of June; subsequent rains ran the soil together, and the heat of the sun baked it into a solid substance through which the potatoes could hardly force their sprouts; the crop was barely 50 bushels per acre. In April, 1859, $7\frac{3}{4}$ acres were underdrained four feet deep and 33 feet apart generally, there being 623 rods of drains; the labor cost \$132, the tiles, as near as possible, \$100, being in all \$30 per acre, or \$232; the preparation, sowing, tillage and harvesting of the crop cost \$21 per acre. The whole expense of underdraining and cultivation of $7\frac{3}{4}$ acres was \$408. The crop was— $4\frac{1}{2}$ acres mangel wurzel, 1,800 bushels; $3\frac{1}{4}$ acres carrots, 1,600 bushels; total, 3,400 bushels, at 10 cents—\$340—leaving, at this low estimate of price, a deficiency of only \$68, to pay for the permanent improvement and all the expenses of cultivation, from the first year's crop. The value of mangels in England is generally considered 50 per cent. more than turnips. This crop also was produced without any manure, (and from the defective method of sowing or other causes fully one-third of the seed missed,) but, as I wished to test the benefits of thorough draining, I think it has exhibited a very satisfactory result without. This field I shall sow with spring wheat this year, and I hope to be able to give an equally favorable report next harvest. It cannot be said that the low cost of the labor done last spring and summer was owing to the small demand for labor, for all of my men earned above the average of wages during the whole time; one set of men earned 4s $11\frac{1}{2}$ d, wanting a fraction of \$1 per day; another nearly 4s, and a third 3s 8d; others again, more unused to handling the necessary tools, earned still less, but this was owing to their own want of skill, which practice of course would soon have cured. The most advantageous manner in which the work can be done is for the men to work in gangs of two each, and when there are a number of gangs at work, for one man to be kept laying in the tiles, which he can easily do in favorable ground for twenty diggers; in ordinary good clay lands a handy workman will easily cut and fill five rods per day. All of these statements, which may be relied upon as strictly correct, conclusively prove that the system of thorough drainage, in point of immediate expense and ultimate profit, is as well adapted to Canada as to the old countries; and my own opinion is, that the effects will be more marked in the former than in the latter.

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